



## Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact [support@jstor.org](mailto:support@jstor.org).

## WATER SUPPLY STANDARDS AND THEIR IMPROVEMENT<sup>1</sup>

BY WILLIAM J. ORCHARD

Water supply standards may be divided into two classes:

1. Technical standards.
2. Non-technical standards.

Technical standards may again be divided into two classes:

1. Official standards, formed by the promulgation of laws and regulations.
2. Unofficial standards, which may be defined as those based on experience or current practice.

A résumé of legislation and the regulations of supervising health bodies indicates that the only definite technical standard that has been promulgated officially is that of the Secretary of Treasury, under date of October 21, 1914, being bacteriological standard of purity for drinking water supplied to the public by common carriers in interstate commerce.

From information available, it would appear that none of the State Health Departments has officially promulgated standards of purity, either bacteriologically or chemically. In many states, legislation exists prohibiting pollution of public water supplies or the sources from which they are obtained. A few of the State Health Departments recognize the standards of the Treasury Department and aim to have all water supplies conform to these limits. Other State Departments of Health have unofficial standards which are used as a means of guidance in interpretation of water analyses, most of these being bacteriological standards only.

Reports received from 31 State Health Departments indicate that 13 states have laws protecting water supplies, but have not adopted any minimum chemical or bacteriological standards. Two states have laws protecting water supplies and have unofficially adopted United States Treasury standards. Nine states have laws protect-

<sup>1</sup> Read before the Richmond Convention, Chemical and Bacteriological Section, May 10, 1917.

ing water supplies and have adopted tentative unofficial standards, while eight states have neither laws nor standards.

Unofficial or tentative standards that have been adopted by some of the State Departments of Health are of interest. A few examples are enumerated:

*Minnesota.* The Minnesota State Board of Health has not set any arbitrary standard for the purity of water. In interpretation of results, a water is not considered to be of good sanitary quality unless the bacteriological count for four days at 20°C. is less than 100 per cubic centimeter, and *B. coli* absent in 100 cc. samples. This standard is subject to qualification under certain conditions. The Minnesota State Board of Health will not report on any water supply unless a thorough field investigation has been undertaken and unless samples have been collected by its own representatives. This phase of the situation is presented in a paper by H. A. Whitaker, Director of the Division of Sanitation of the Minnesota State Board of Health, entitled "Fallacies in the investigation of Water Supplies," which was presented before the engineering section of the American Public Health Association in October last.

*Alabama.* The Alabama State Board of Health recognizes the standards adopted by the Treasury Department, allowing, however, a bacteriological count of 300 per cubic centimeter after twenty-four hours incubation at 37°C.

*Virginia.* The State Board of Health of Virginia has not adopted any standards and in an interpretation of analyses is largely governed by the particular conditions surrounding the source of supply, and even though a water derived from a protected watershed on which there is no habitation might show *coli* in 1 cc. and 10 cc. samples, unless human contamination could be shown, the water supply might be considered as good. For the information of local authorities, however, the Virginia State Board of Health indicates on its standard report forms, the significance of bacteriological counts and *B. coli* interpretations, differentiating between bad, suspicious or good supplies, as follows:

Where colon bacilli are found in quantities of 1 cc. of water, the sample is dangerous, and is reported bad, regardless of the number of other bacteria found in the sample.

Where colon bacilli are found in 10 cc. or 20 cc. of water, and the number of other bacteria is large, the sample is regarded as dangerous, and is reported bad.

Where colon bacilli are found in 10 cc. or 20 cc. of water, and the number of other bacteria is small (less than 500 per cubic centimeter) the specimen is classed as suspicious.

Where colon bacilli are not found in samples; and, where bacteria are less than 500 per cubic centimeter, the sample is reported good.

*Maryland.* The State Department of Health of Maryland has not established any standards or limits on the quality of public water supplies, but certain standards have been recommended for filtration plants. These standards are quite novel and are based on a coefficient of efficiency, which is defined as "the ratio of the logarithm of raw water count at 20°C. to the logarithm of the plant effluent count." For the removal of colon, the standards are based on a so-called "standard hygienic efficiency," which is defined as "the sum of the percentages obtained by allowing a value of 20 per cent to each successive step in the colon removal." These standards are discussed in detail in a paper by Wolman, published in the *American Journal of Public Health*, November, 1916.

*Montana.* The Montana Department of Health has adopted tentative chemical standards for the hygienic purity of waters, applicable to restricted areas in the state, and, as a rule, only supplies that show no *B. coli* in 10 cc. are recommended for public consumption.

*California.* The California Bureau of Sanitary Engineering considers a supply in which *B. coli* can not be confirmed in 10 cc., by the latest laboratory methods, as being safe. The occasional occurrence of *B. coli* in the same quantity is not considered seriously, but their presence in 10 cc. continuously, or in less than that amount occasionally, is not considered favorably. Condemnation is usually reserved for a field inspection to determine if possible what portion of the *B. coli* are of human origin.

*Iowa.* Iowa presents the interesting situation where chemical standards adopted for the waters of the state several years ago have been abandoned, following the collection of information showing their inadequacy.

A résumé of reports received from over 30 State Health Departments shows the varied interpretations placed on bacteriological analyses, and the relative importance given to sanitary survey of watersheds in conjunction with analyses.

If the standards of the United States Treasury Department must apply to all water supplies used in interstate traffic, and, if as experi-

ence has clearly shown, supplies used by railroads can conform to Treasury standards, the interesting contention is presented that all public water supplies should conform at least to this standard.

If all supplies do not measure up to this standard, the regulation works an injustice on a few supplies, and does not accomplish a general improvement in the water supplies of the country, as might otherwise be the case.

If there are two towns, located one on either side of the state boundary, designated as A and B, A being a watering place for railroad equipment and B being a way-station, according to existing legislation, the supply of A must conform to the Treasury standard, and the supply of B can be anything that the state and local officials will permit. To make the water supply of A conform to the standards has, in all probability, placed a burden either on the water company or the tax payers of the municipality, and has correspondingly improved the welfare of the town. Is it equitable to require A to go to this expense and not to impose a similar obligation on B? On the other hand, in justice to the consumers at B, should they not be afforded the same protection as those at A?

It is appreciated that in suggesting the feasibility of adopting tentative minimum bacteriological standards, the principal objection to such procedure is the inability properly to consider the sanitary surroundings of the source of the water.

The abundant good that has been accomplished on a relatively few supplies, following the establishment of Treasury standards, however, would indicate that a considerably greater number of supplies could be improved, should minimum standards be promulgated for all of them.

Whether or not we are governed by arbitrary or tentative standards, more or less definitely fixed, those who in the course of their work are called upon to interpret large numbers of bacteriological analyses, unquestionably are governed by standards that they have set, upon which the interpretation is based, and this interpretation is made, first, without reference to a sanitary survey; and, second, in conjunction with a sanitary survey to determine, if possible, the sources of any apparent pollution. But these personally established water standards vary with the individual's interpretation of the analyses.

A water showing coli in 0.1 cc. regularly will unquestionably be

condemned, as will also, without doubt, a supply usually showing coli in 1 cc.

A water showing coli frequently in 5 cc., and occasionally in 1 cc., will very likely be rejected by most sanitarians, although the frequency with which such supplies are furnished to consumers, without rigorous steps being taken to improve the quality, is surprising.

When we reach a water, however, with coli present frequently in 10 cc. quantities, and occasionally in smaller amounts, the interpretation of the analysis lies very largely with the individual, and the supply may be rejected or passed in accordance with the individual's standards.

Although the difficulties of arbitrarily establishing any minimum bacteriological standard are appreciated fully, it would tend greatly to improve the quality of a great number of supplies, if minimum standards, adopted after careful investigation, were to be officially promulgated by this Association. Should such standards be available for water companies, commissioners and consumers, a definite object would be established, and the best results in any line of endeavor are secured only when a definite objective is in view. On the other hand, should such minimum standards be established, being intelligently drawn and formed only after due consideration of geographical conditions, they would unquestionably aid the supervising health officials in dealing with the recalcitrant water vendor, for the state sanitary engineer would have a definite objective that he could order the vendor to reach.

Although the United States Treasury standards are high as compared with many water supplies in this country, and although a large number of waters of our bigger and better known cities will not at all times conform to the Treasury standards, they are not high as compared with the standards existing in European countries and Great Britain.

It was expected that a considerable fund of authenticated information would be available to incorporate in this paper to cover standards prevailing in these countries, and the limits of bacteriological content that are considered good practice. Presumably, this information has been lost in transit and will have to be incorporated subsequently. Many English water works men, however, contend that the total bacteriological content after twenty-four hours incubation at 37°C. should not be more than 50 per cubic-centimeter, and that colon should be absent in 100 cc. quantities

after seventy-two hours incubation at 37°C. and some even go as far as to aim to have colon absent in 200 cc. after seventy-two hours incubation at 37°C. An examination of the Twelfth Research Report of the Metropolitan Water Board, of London, would indicate that the settled, stored and treated waters of various supplies before filtration were comparable bacteriologically with some of our American water supplies as delivered to the consumer.

In advocating the adoption of minimum bacteriological standards of water, the object in view would be to improve the poorer supplies and to establish a guide by which a non-technical water-works man could appraise his supply, to establish standards not so much as an arbitrary means of appraisal as an incentive to secure better water supplies. It is therefore suggested that consideration be given to the appointment of a sub-committee to determine the practicability of adopting standards similar to the United States Treasury standards for all water works, whether they be used for inter-state traffic, or not.

#### NON-TECHNICAL STANDARDS

Technical standards are easily explained in scientific terms intelligible to those familiar with their use. Non-technical standards are more difficult to explain but may be defined as the attitude of the non-technical man toward a water used for domestic purposes. These may well be divided into two classes:

1. The standards of the non-technical water works man.
2. The standards of the consumer.

It must be realized that there is a large number of water works men in this country, not members of this Association, who do not know to any extent the necessity of a pure water supply, and to whom the colon bacillus and bacterial flora in general are unknown. Fortunately, the number of water works in charge of this type of man is fast diminishing. The only reason that so many non-technical water works men are entirely unfamiliar with the need of safe water, and the care and vigilance that must be used to secure a safe supply, is that they do not know the fundamental reasons for a safe supply. Two instances are worthy of mention:

A certain surface water supply in New England, upon investigation following a typhoid epidemic, was almost definitely found to have been polluted by a typhoid-carrier hunter. The State Board of Health representative, sent to install a temporary treatment

plant, was ordered out of the pumping station by the water commissioners who waited on him in a body, to inform the Board of Health man that they were running that water works; that the water supply suited them; and, State Board of Health or no State Board of Health, he could not install the treatment plant, and the only thing he could do was to get out, which, having no authority under the law, he did.

The second instance is that of a water works superintendent of a small municipality which was required by the State Health Department to install a treatment plant. Upon the arrival of the representative of the company furnishing the purification apparatus, the superintendent roundly abused the State Board of Health officials, ridiculed the necessity for treatment, in spite of the prevailing epidemic, and informed the representative that he was not going to permit the State Board of Health to install any more contraptions that would mean more work for him; and that although he would treat the water while the State Board of Health man was around, he would pay absolutely no attention to the equipment at other times. Subsequent experience has indicated only too well that he carried out this threat.

Such attitudes on the part of non-technical water works men are only too familiar to those whose work has as its foundation the improvement of water supplies in general, and it can be combated only by a most aggressive educational campaign, which properly should be supervised by this Association.

Contrast with this attitude that of the progressive private water company or the water department conducted by a technical man, or by individuals who realize the vital importance of their work. The large progressive water companies or departments take every possible means at all times to improve their water supplies; to raise the standards by which they are appraised and by which the consumers are influenced. Such water companies, by taking the consumers frankly into their confidence, place themselves on such a firm foundation as to be able to withstand whatever adverse criticism may be directed against them.

The experience of the Indianapolis Water Company, of Indianapolis, Ind., which has taken its patrons into its confidence in regard to the treatment of its water supply and has established a reputation in Indiana of furnishing absolutely safe water under all conditions, is worthy of note. This confidence has carried the water



company without criticism through two severe epidemics and has been invaluable in the matter of dollars and cents as well as good will. A similar attitude on the part of other water companies has had a comparable result. Is it not incumbent upon this organization to endeavor to create a similar attitude on the part of every water vendor?

The water standard set by the consumer is for the most part one of appearance. If a water is not turbid or colored, he is usually satisfied. Unless his immediate family has been vitally touched by the effects of an impure water supply, he is not solicitous about the quality of the supply. This matter was discussed at length by Johnson in his paper, "The Typhoid Toll," presented before this Association, and was amplified in the printed discussion of that paper.

The consumer is, however, inextricably connected with the establishment of higher standards for a water supply. To obtain better water supplies, money is needed and a considerable quantity of it. A water company cannot improve its supply without incurring expense, which should bring return in the shape of increased rates, and increased rates can only be obtained with the partial consent, at least, of the consumer. Similarly, municipal supplies, if improved, increase the tax rate, and here again the consumer is the court of last resort.

The complacent and erroneous impressions that many water consumers have in reference to their supplies must be eliminated by careful, painstaking publicity and education. In discussing water supplies of various communities with non-technical men and water consumers, one is frequently advised that the water supply is the purest in the country; that it is 99.9 per cent pure; or, that it is well water that never sees the light of day and is absolutely safe. The individual cannot be blamed for resting secure in these assertions, for he does not know better.

Most of those present at this meeting, in going into a strange city or town, do not drink the water furnished until the nature of the supply has been ascertained. Many of us abstain from drinking water when on road trips, even in territories where other liquid refreshments are not easily obtained, simply because we appreciate the pollution that a water may carry and the danger that may lurk in a tumblerful. The average consumer, however, seldom gives this matter a thought, because his training has not taught him to do so.

Should this Association be instrumental in making the water consumer stop before he draws a tumblerful of water from the spigot and inquire as to the purity of that supply before he drinks the water, it would have a tremendous effect on the improvement of water supplies.

A more complete and masterful presentation of the value of pure water than that contained in Johnson's paper, "The Typhoid Toll," was probably never presented before any Association. In it, the author says that more people are killed every year by typhoid fever than by railroads. The water consumer will stop and look before he crosses a railroad track, we must make him stop and think before he drinks a glass of water. Mr. Johnson has shown that a pure water supply is a good dollars and cents business proposition; why not treat it as such? Why not pattern our conduct as a water works association after that of a successful business organization? Are we not at all of us, water works superintendents, engineers, chemists, bacteriologists, manufacturers, or what not, offering our services and our product, water, to our final customer, the consumer? Being honorable men, we want to give him the best that he will pay for, and he will only pay for the best when he is educated to its need. With the consumer educated and demanding the best in water supplies, there will be no further danger from the non-technical, disinterested, or slovenly water works vendor, for he will not be permitted to do business.

Looking at this matter, then, as a business proposition, seeking to find a market for a water supply of higher standards than most of those at present furnished, should it not be approached in the same manner as any successful business campaign? Given a good product for which there is a market, the success of any business depends on bringing the product to the attention of those using it, and that can only be done by advertising and publicity. Why not have this Association act as an advertising or publicity medium to obtain higher standards on the part of the technical and non-technical water works man and also the consumer? Begin with the consumer; advertise to him the value of better water so that he will demand the best, and be willing to pay for it. Then, he will get it.

The efforts toward improvement made by vendors of water used in interstate commerce, which could not be certified under Treasury ruling, are significant of what can be done under compulsion. How much more could be accomplished if the consumer was the compelling

force all over the country? We are all familiar with the progress made in campaigns to secure better housing, better factory conditions, better environment for employees, and protection from occupational diseases? We are also familiar with the tremendous strides in the anti-tuberculosis campaign, and the many exhibits used to educate the public along these lines. Many State Health Departments have traveling exhibits in charge of medical or technical men, which tour their states to give the public visible evidences of the results obtained from money they have expended.

Are we not lacking in the fulfillment of the highest objective of this Association unless we endeavor by every means at our disposal to educate the general public as to the value of pure water? Are we not stultifying the influence of Johnson's paper if we confine it, for the most part, to the technical water works man? Should we not see to it that its contents are advertised broadcast as a good business proposition?

Let us suppose that graphic illustrations of the value of pure water were to be incorporated in every public health exhibit in the country; were to be made part of traveling exhibitions; to be incorporated by the Boards of Education in instructions given in school rooms, and disseminated by every educational medium. It would not be long before the demand for better water would be so insistent as to cover the entire country.

And, with the objective of creating this demand on the part of the consumer, and thus offsetting the deleterious influence of the careless water vendor (and to support the technical water works man in the promulgation of higher standards of water supplies) this suggestion is offered: that this Association appoint a committee to consider the feasibility of a joint board to consist of four members, one each appointed by the Presidents of the American Water Works Association, the New England Water Works Association, the American Public Health Association, and the Water Works Manufacturers Association, these four men to appoint a publicity or press agent, who might well be one of the Secretaries or Editors of those Associations, whose sole duty would be to spread the propaganda of better water supplies. There are many problems presented; the cost of broadcast publicity at first would be prohibitive, but intensive advertising campaigns could easily be conducted in certain localities.

Sub-committees could be appointed to confer with various State

Departments of Health, covering publicity in their territory. Other sub-committees could be appointed in some states, if necessary, to endeavor to secure legislative enactment to protect water supplies, and create an interest in the subject. Arrangements could be made with some of the larger private water companies to advertise steps they have taken to protect their supplies along the lines previously mentioned as having been undertaken by the Indianapolis Water Company. Other sub-committees could make arrangements with the boards of education, libraries, and exhibits.

This is a tremendous undertaking, but unquestionably it is worth while. It is a campaign which would take years to properly cover the country, and it is not to be expected that the tangible results would be immediate. That the end to be accomplished is a good one is beyond dispute, and in aiding to spread the gospel of pure water, this Association will fulfill its highest function.

### DISCUSSION

F. W. GREEN: At Little Falls, N. J., the water has an average bacteriological content of 2 bacteria per cubic centimeter and at the same time a *B. coli* index of 0.03; this means about 3 *B. coli* per 100 cc. The company considers the water not only the best in its section but one of the best in the country. In Paterson, a city of 125,000 population, the typhoid rate is 9 per 100,000, which is about the lowest in the country for a city of its size, and practically the same rate obtains in the other municipalities served.

It is not possible to make a standard that will cover all cases. There are many places where water is filtered and the supply undoubtedly contains *B. coli*, yet that supply is perfectly safe. There are a number of large cities where the supply, taken from surface streams, is such that it is difficult to determine the exact amount of sterilization necessary to eliminate the coli. To remove the last innocent *B. coli*, which is not a sign of harmful pollution but only indicative of a possible danger, it is necessary to dose in more chemicals to increase the sterilization, and that causes complaint of tastes and odors besides incurring more expense.

CHESTER G. WIGLEY: The paper brings out a point, quite clear to any one supervising different water supplies, that the standards used by different departments vary very considerably. This is

possibly because the bacteriology of water supplies has not yet reached an absolutely definite position. The tendencies are toward refinements of the present procedures, and until those refinements have been worked out it is a rather difficult proposition to establish any definite standards. The standards of the Public Health Service have been of considerable value to those in charge of the water supplies of cities and states on account of their influence toward the betterment of supplies.

The subject of railway water supplies is probably in a somewhat different category from that of the municipalities. A railway picks up its supply at some point along its line, and it is often not a very severe task for it to substitute an unquestioned source of supply for one under suspicion. On the other hand, a municipality is frequently tied up with very heavy investments on its water shed, over which the most careful control must be maintained at all times to supply a water that is in any degree safe.

It is a question whether at present it is prudent to establish any standards except those which experience has shown to be absolutely necessary. In the last analysis the health of a community using a certain water supply is practically the only absolute measure of the quality of that water. In time a more definite standard will be worked out, but attention is called here to a point made by Professor Jordan, of the University of Michigan, in a paper on the bacteriological standards for food products, published in the *Journal of the American Medical Association*. This point is the danger of establishing standards for food products beyond those which it is absolutely certain are indicative of the quality of those products, his opinion being that to establish standards beyond those which bacteriology had demonstrated were absolutely necessary for safety might in the end lead to a repetition of the experience of the Royal Commission on Sewage Disposal of England. That commission, establishing standards ahead of the development of the science, was under the necessity later of amending in some way those early standards, the result being that the portion of the public affected naturally lost a certain amount of confidence in the technical ability of those responsible for the adoption of the standards.

The author has advanced one very important matter for consideration, the subject of publicity. It is a well accepted fact now that the greatest force that can be used in any public health work is publicity, and that matter should have the earnest consideration of

this Section. It is a large subject which has not yet been given much thought.

EDWARD BARTOW: The suggestion just made regarding publicity recalls a notice that was printed for years on the menu cards of a Champaign hotel: "This water has been analyzed by the chemists of the University of Illinois and found to be absolutely pure." The University has made no analysis of the water used in that hotel, unless it was a very long time ago and an ancient analysis been advertised for years and years.

The paper suggests a joint committee representing four societies to consider the advisability of combined action in matters relating to standards of water supply. The paper mentions the American Chemical Society as particularly interested in chemical analytical methods and standards, the Society of American Bacteriologists and the American Public Health Association as interested in bacterial standards, and the American Water Works Association as interested in teaching the public about the value of good water. It might be well to add the American Railway Association, which has already established standards for locomotive water supplies. The chemical standard of water is very important to railways and many industries.

JOSEPH RACE: One of the most important points raised by the author is the United States Treasury or Public Health Service standard. It ought to be seriously considered by this Section because, on account of its application to interstate carriers, it practically sets a minimum standard for the whole country. It also seems inevitable that, in the absence of opposition, it will become the standard for the contiguous territories of Canada and Mexico. In Canada, the question of standards has already arisen in connection with international water carriers. The Washington authorities made regulations some months ago and attempted to put them into effect at the opening of the present season of navigation. At the request of the Canadian authorities the proposed regulations were suspended for twelve months so that the two countries could consider and adopt regulations that would not conflict.

Two points ought to be considered in connection with this standard. First, what method is to be used for the determination of *B. coli*? If the method is to be that of the American Public Health Association, which apparently changes every time the Association's

committee makes a report, the result will be chaos to water works. Water works managers ought to take more interest in the standard methods of analysis and insist upon less frequent changes. Second, what is the minimum time that may be permitted between the collection of the samples and their examination? In supplies like reservoir and filtered waters the bacterial conditions may have reached an equilibrium and but little change will then occur during a further period of storage. In waters that have been treated with chlorine the case may be quite different and the *B. coli* content may be very much less after twelve hours. It is very desirable to adopt a standard method of procedure.

L. I. BIRDSALL: In regard to the publicity side of water works affairs, conditions in Minneapolis may be mentioned. The Department has been laboring for the last four and a half years, ever since the filtration plant was established, to convince the people that they are being supplied with pure water. The spring water people have persistently said all manner of mean things about the municipal water supply, which is taken from the Mississippi River. In its campaign of publicity the Department started out with an official guide at the filtration plant and since then on an average 10,000 persons have visited it annually. Then pamphlets were issued explaining the whole system, how the water is purified, how it is proved to be pure, and giving some of the results of tests of its quality. These pamphlets are sent out with the water bills and one reaches every consumer. Another means of publicity is the use of stereoptican slides. A number of organizations in the city ask the department heads to talk to them about water, which is done gladly with the help of these lantern slides. One of them shows a reduction in the typhoid fever cases in Minneapolis from 58 per 100,000 in 1910 to 4.7 in 1916. The results in this publicity work are becoming apparent and the people of the city are coming to realize that they are obtaining pure water.